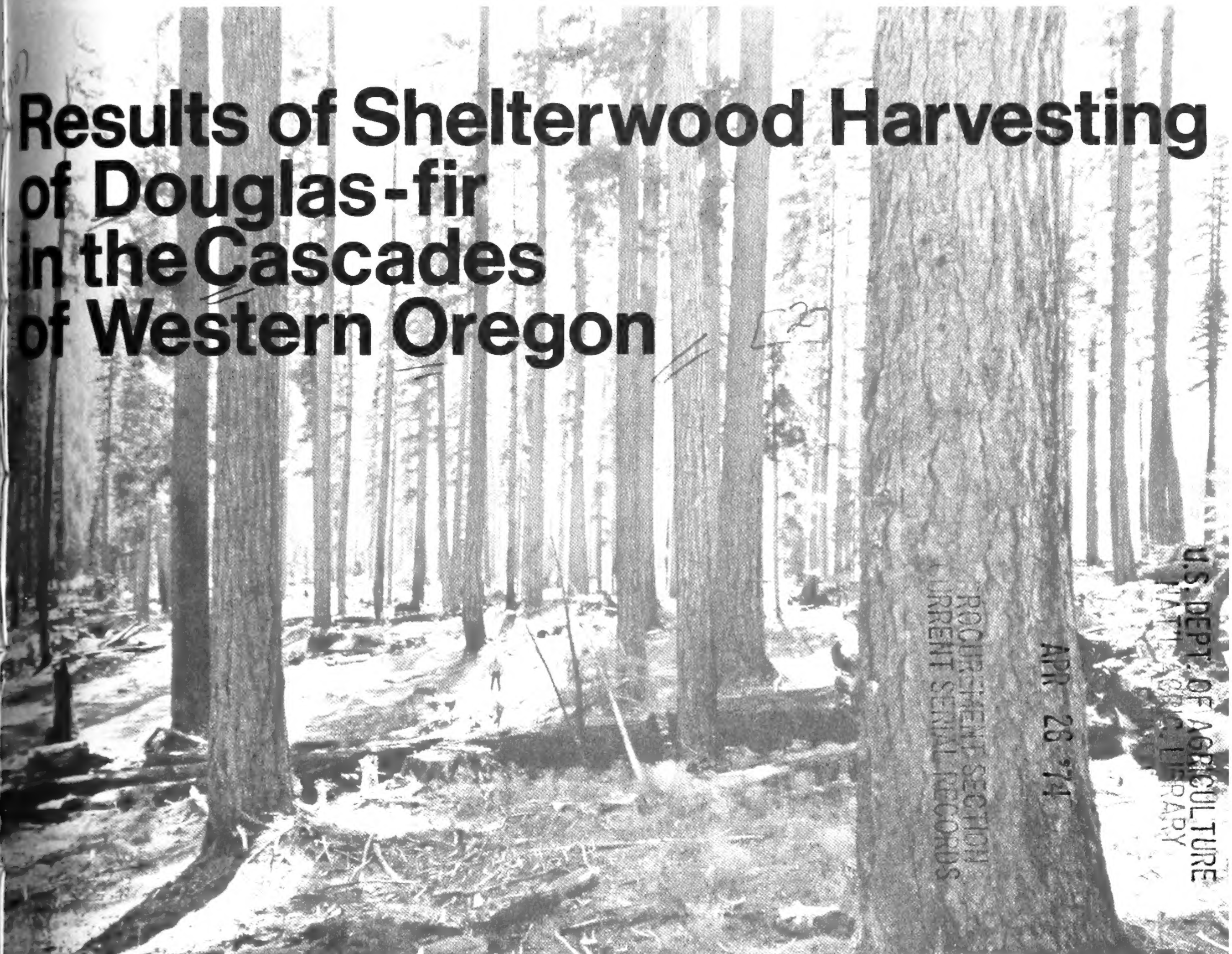
1973
USDA FOREST SERVICE RESEARCH PAPER PNW-161

Results of Shelterwood Harvesting of Douglas-fir in the Cascades of Western Oregon



Richard L. Williamson

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PORTLAND, OREGON

ABSTRACT

The U.S. Forest Service started trials of shelterwood harvesting coastal Douglas-fir at high elevations in the western Oregon Cascades in 1962. In 1970, 21 shelterwood units, at least 2 years old, were available. Natural regeneration and site conditions in these units were assessed through a systematic survey using 4-milacre circular plots. Overstory condition was assessed through strip surveys. Site preparation (at least 25-percent exposure of mineral soil) results in satisfactory stocking if overstory density is sufficient; lack of site preparation results in unsatisfactory stocking of Douglas-fir and leads to species conversion. If one accepts that 70-percent stocking of 4-milacre plots is a desirable objective, then shelterwood density of 100 to 180 square feet of basal area per acre is tentatively recommended. Stands with larger average d.b.h. require greater shelterwood densities (basal area) to produce a given amount of shade than do stands with smaller average d.b.h. Shelterwood overstories experience little mortality.

Keywords: Douglas-fir, shelterwood system, forest regeneration (natural).

INTRODUCTION

U.S. Forest Service experience has shown that clearcutting Douglas-fir in the Pacific Northwest does not always result in successful regeneration, either natural or artificial. Where regeneration has failed, this has been due to such causes as temperature extremes and drought. Failures, primarily at higher elevations in the Oregon Cascades, led the Forest Service to try shelterwood harvesting, beginning in 1962, as a possible alternative to clearcutting. I surveyed these initial shelterwood stands in summer 1970 with two main objectives:

1. To determine how successful shelterwood harvests were in securing natural regeneration.
2. To determine survival and condition of the shelterwood overstories during the regeneration period.

A total of 21 shelterwood cutting units were available and examined. All were at high elevations (3,000-5,200 feet) in the Cascades of western Oregon. The units ranged from the Mount Hood National Forest, just south of the Columbia River, to the Rogue River National Forest in the vicinity of Butte Falls (fig. 1). Brief descriptions of each unit's location, stand, and environmental factors are summarized in table 1. On the Butte Falls District of the Rogue River National Forest, three of the four units (18, 19, and 20, table 1) actually were in the mixed conifer type so that there were many fewer Douglas-fir than other tree species in these residual overstories. In unit 19, no Douglas-fir trees were in the sample though several were observed outside the sampling strip. These units were examined primarily to see how successful Douglas-fir regeneration was under these minority conditions.

In all areas, shelterwood trees were vigorous dominants and codominants from the original stands. The residual density of a few (units 3, 4, 5, 6, and 10) of the "shelterwood" stands actually fell in the "seed tree" density classification (less than 25-percent residual basal area).[1] In all units, foresters attempted to prepare an adequate seed bed for Douglas-fir through piling and burning of duff and slash. Success of seed bed preparation varied, apparently depending on skill of tractor operators and weather. As far as could be ascertained, none of the units were rodent-baited.

---

[1] David Martyn Smith. The practice of silviculture. New York, John Wiley & Sons, Inc., 578 p., illus. 1962.

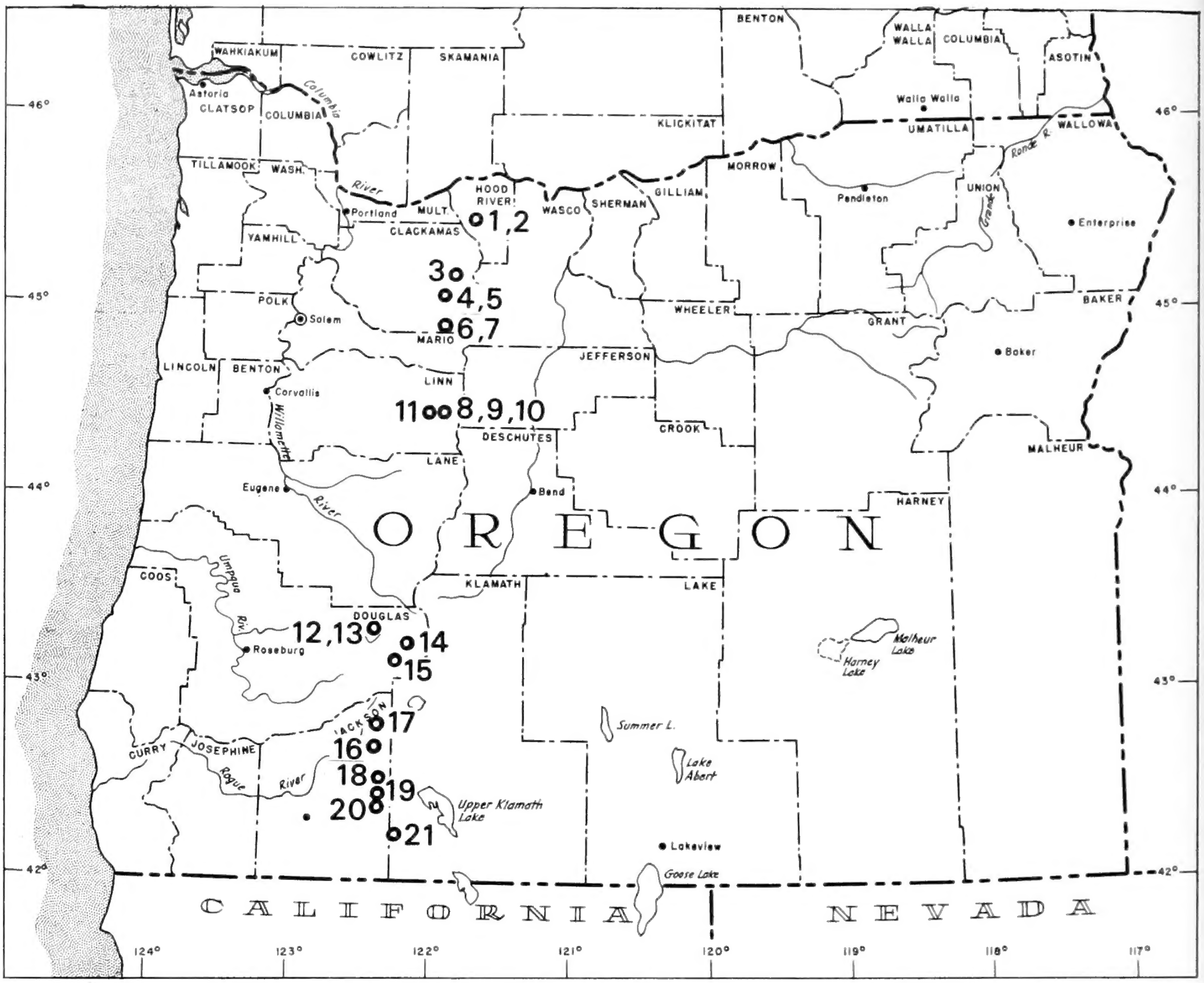


Figure 1.--*Study area locations.*

Table 1.--*Some characteristics of shelterwood areas in the Cascades of western Oregon*

Unit number and name	Unit size	Elevation	Slope	Aspect	Start of regeneration period	Residual overstory: Basal area	Residual overstory: Approximate normal basal area	Residual overstory: Quadratic mean d.b.h.	Trees per acre: All	Trees per acre: Douglas-fir	Minimum number of seedlings per acre: Douglas-fir	Minimum number of seedlings per acre: All	Quadrats: Stocked: Douglas-fir	Quadrats: Stocked: All	Quadrats: Number
	Acres	*Feet*	*Percent*			*Square feet*	*Percent*	*Inches*	*Number*	*Percent*			- - - *Percent* - - -		
1. Silver Dollar 2	46	3,000	15	NE	1966	143	48	24.5	44	42	730	2,690	50	88	18
2. Silver Dollar 3	41	3,000	15	N	1966	168	56	25.3	48	56	400	1,200	59	77	22
3 Countersunk	12	3,500	10	S	1967	54	16	27.5	13	98	200	220	50	50	16
4. Frazier Mountain 3	35	4,000	15	E	1968	22	7	28.6	5	90	20	140	12	23	26
5. Frazier Mountain 6	10	4,000	15	SW	1968	35	11	37.3	5	100	310	590	65	74	23
6. Peavine Slope	30	3,000	10	N-S	1966	38	12	24.0	12	--	2/980	1,070	88	94	17
7. Pinhead Creek	15	3,300	5	NW	1963	103	29	33.9	16	100	2/1,300	1,410	93	100	15
8. North Santiam 1	12	3,700	0	--	1962	130	35	57.6	1/8	88	620	930	71	76	24
9. North Santiam 2	13	3,800	0	--	1962	155	41	48.6	1/10	70	890	1,470	86	90	21
10. North Santiam 3	12	3,800	0	--	1964	65	17	49.8	1/4	88	480	620	54	67	24
11. Big Spring 1	12	3,600	15	N-S	1962	108	29	44.5	1/9	84	310	550	56	64	22
12. Burma Road 31-1A	14	3,600	0-25	S	1968	101	28	47.6	8	100	1,330	1,380	78	78	18
13. Burma Road 31-2A	51	3,600	0-25	S	1968	144	40	55.8	8	100	2/1,390	1,400	76	76	25
14. Mowich	98	4,000	0	--	1964	63	20	48.1	5	98	1,160	1,230	82	84	43
15. Watson Creek	75	5,200	0-25	W	1967	82	23	44.2	8	66	2/1,730	1,990	100	100	22
16. Ski Area	7	3,400	0	--	1968	83	23	44.4	8	85	2/1,870	2,040	100	100	16
17. Lost Cause	20	3,700	0	--	1968	128	36	38.2	16	54	2/2,330	3,410	100	100	21
18. Zimmerman	24	3,800	0-15	W	1968	101	34	24.8	30	19	570	1,020	60	60	10
19. River Road	20	4,400	15	NE	1968	83	28	27.4	20	0	220	1,310	54	100	11
20. Noman	25	4,000	15	N	1965	169	53	33.6	27	18	560	1,010	70	80	20
21. Bourdon Spring	20	4,600	25	W	1966	74	25	31.0	14	48	340	400	54	54	22

1/ Based on complete overstory tree count by Dr. Jerry F. Franklin, USDA Forest Service, Forestry Sciences Laboratory, Corvallis, Oregon.
2/ These means resulted when seedling counts were arbitrarily limited to 10 seedlings per plot.

METHODS

NATURAL REGENERATION

Regeneration and site conditions in each shelterwood unit were assessed through a systematic survey of 4-milacre circular plots. Sampling intensity was light, averaging about 0.4 percent. Data on each plot included:

1. Number of natural seedlings (10 maximum), at least 2 years old,[2] by species.
2. A wedge-prism (BAF-10) estimate of shelterwood basal area surrounding each quadrat.
3. An ocular estimate of current canopy density of lesser vegetation.
4. Type of seed bed created by site preparation and logging:

   Mineral soil, 100-75 percent of plot area

   Heavily disturbed with 75-50 percent in mineral soil

   Lightly disturbed with about 50-25 percent in mineral soil

   Undisturbed duff and litter, less than 25 percent in mineral soil.

Even 8 years after site preparation, seed bed conditions could be identified by type of disturbance. The compacted duff and litter that ordinarily carpet the forest floor apparently did not readily disintegrate when exposed by shelterwood cutting. Forest litter and duff were easily discernible from herbaceous and shrubby vegetation litter formed after site preparation.

THE OVERSTORY

Overstory condition was assessed through systematic strip surveys designed to sample at least 50 residual trees per unit. If a unit was too small to have 50 trees, all trees were assessed. Strips were one-half chain wide, with total length based on unit sizes and residual tree densities provided by the Ranger District. These surveys included:

1. Descriptions of any damage on each live tree.
2. Probable cause of mortality for dead trees.
3. D.b.h. of all sampled trees, including trees that died during the regeneration period.

---

[2]Seedlings alive and vigorous in August of second growing season were assumed to be 2 years old.

SUPPLEMENTARY DATA

I had planned to use the wedge-prism estimates of overstory basal area as one of the major predictors of regeneration success in the analyses of data in this study. It is easy to estimate stand basal area. I recognized that overstories influence the survival of seedlings primarily through provision of shade, but shade cast by overstories is difficult to measure. I hoped that basal area estimates would sufficiently indicate amounts of shade and, consequently, regeneration success. Part way through the survey (after surveying unit 3), it was apparent that even an ocular estimate of overstory shade might be a better estimator of regeneration success than the wedge-prism basal area measurement. Such an estimate of shade seemed desirable because I could see that different stands of the same basal area per acre could cast substantially different amounts of shade. For most units after unit 3, I estimated the percentage of total ground area in each cutting unit that was shaded by the overstory at noon, and made this estimate from the highest available elevation within or adjacent to the cutting boundary.

RESULTS AND DISCUSSION

NATURAL REGENERATION

Average Seedling Density

Results from the stocking surveys were consistent with expected changes from results of similar surveys made by U.S. Forest Service District people in previous years; i.e., additional time resulted in some improvement in stocking. In most cases, regeneration stocking is at least adequate by U.S. Forest Service Region 6 standards. These standards require a minimum of 250 uniformly distributed 4-year-old trees per acre, or greater numbers of younger trees.[3] Douglas-fir seedlings, which were at least 2 years old (average about 4 years), averaged at least 845 per acre (range 20 to 2, 330); seedlings for all species averaged at least 1, 242 (range 140 to 3, 410) (table 1). These means and ranges resulted when seedling counts were arbitrarily limited to 10 seedlings per plot. Region 6 standards also consider 50-percent stocking of a sample of 4-milacre quadrats satisfactory. Both standards assume seedlings are well distributed throughout the sampled area. Average stocking for these data is 69 percent (range 12 to 100 percent) for Douglas-fir seedlings. Satisfactory stocking in two shelterwood units (units 8 and 9, table 1) was particularly gratifying to me because I had personally made stocking surveys in the mid-1950's in some nearby older clearcuts which had experienced repeated plantation failures. These repeated failures indicated particularly severe local environmental conditions, which shelterwood harvesting apparently mitigated.

A few of the shelterwood units (southwest Oregon only) were planted to Douglas-fir or ponderosa pine. Not enough units were planted to warrant formal study of the success of these operations. However, planted seedlings, where noted, invariably appeared to be vigorous and to have good survival percentage.

[3] Forest Service Manual 2472.1.11.2.

Seed Bed Influences on Seedling Density

Seed bed preparation is one of the more important causes of variation in seedling density and distribution in these study areas. As expected, stocking percent by seed bed type for each unit showed that the mineral soil seed beds were more effective in promoting natural Douglas-fir regeneration than was undisturbed duff (table 2). Also, the mineral soil types have percentages of seedlings in Douglas-fir that are about twice the percentage of undisturbed duff (table 2). Thus, lack of seed bed preparation could lead to species conversion.

Table 2.--*Percentage of stocked quadrats by seed bed types, for Douglas-fir only and for all species together*

Seed bed type	Percent stocking (mean)		Douglas-fir as percent of all seedlings
	Douglas-fir	All trees	
Mineral soil	83	88	62
Heavily disturbed	78	83	79
Lightly disturbed	68	78	67
Undisturbed duff	29	50	34

Areas where slash and duff were removed had a marked reduction in lesser vegetation (notably, ceanothus spp. and bracken fern) when compared with undisturbed areas (fig. 2, A and B). However, these data did not permit

A B

Figure 2.--*Effects of site preparation on brush development, 8 years after shelterwood cut: A, This portion of North Santiam unit 1 had little site preparation; B, this portion of North Santiam unit 2 had good site preparation.*

evaluation of this consequence of seed bed preparation on seedling density because lesser vegetation canopy density was not tallied by species. Individual species obviously differ greatly in their effects on Douglas-fir seedlings, and, in turn, are affected differently by site preparation.

Overstory Density Influences on Stocking

Residual overstory density primarily affects seedling survival by providing shade. Shade is especially helpful in severe-site locations where lethal soil surface temperatures or drought can be expected.[4 5 6] Even in the middle of compacted landings, shade can make the difference between seedling life or death (fig. 3). Openings as small as about one-half acre were observed to have inadequate stocking in severe-site situations. Where suitable overstory trees are not available, one may have to resort to fill-in planting with shade provided by chunks of wood or manually placed objects.

Figure 3.--*Numerous seedlings, like the one near the pencil end (shown by arrow), existed in the shade of a windthrown tree in the middle of a large, compacted landing. Few seedlings existed elsewhere in the otherwise unshaded landing.*

---

[4] Roy Ragnar Silen. Lethal surface temperatures and their interpretation for Douglas-fir. Ph.D. thesis, Oreg. State Univ., Corvallis, 170 p., illus. 1960.

[5] Jerry F. Franklin. Natural regeneration of Douglas-fir and associated species using modified clear-cutting systems in the Oregon Cascades. USDA For. Serv. Res. Pap. PNW-3, 14 p., illus. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg. 1963.

[6] Don Minore. Shade benefits Douglas-fir in southwestern Oregon cutover area. Tree Plant. Notes 22(1): 22-23, illus. 1971.

My ocular estimates of overstory shade were a little more closely correlated with stocking percent of Douglas-fir seedlings (after arcsin transformation of percentages, $r = 0.53$ with 11 degrees of freedom) than were my prism estimates of residual basal area per acre. However, analysis and discussion below are based primarily on basal area, since it is much easier for foresters to estimate and use.

Within limits, the denser the overstory, the greater the percentage of stocked quadrats for any given seed bed condition (fig. 4).[7] Note that with good site preparation (heavy disturbance), almost any reasonable overstory density will produce satisfactory stocking. I think this result is attributable to the generally mesic conditions prevailing in the localities of these units. Mesic conditions were assumed if adjacent, older clearcuts have generally restocked satisfactorily through planting or have a favorable combination of slope, aspect, and physiographic position.

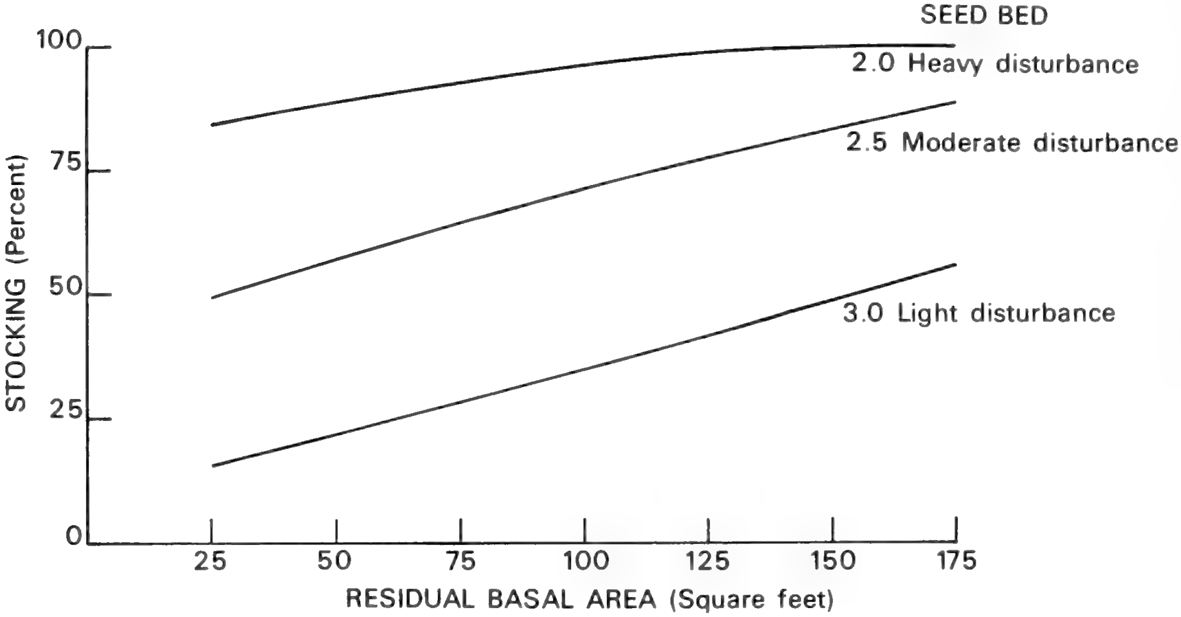


Figure 4.--*Stocking percent related to residual basal area and kind of seed bed.*

There are indications that overstory densities above about 50 percent of normal basal area are too dense for satisfactory regeneration. In the Silver Dollar units (units 1 and 2, table 1) the overstories appeared to compete severely with seedlings for soil moisture since seedlings were observed to be much more

[7] Percentage data were transformed by arcsin method prior to analysis. The arcsin multiple linear regression equation is: arcsin $Y = 147.1 + 0.16659$ (BAF-10) - 42.548 (seed bed class). Multiple $R = 0.66^{**}$ with 17 degrees of freedom. Standard error of estimate = 14.2 degrees. Figure 4 illustrates solutions of this equation after retransformation to percentages.

numerous in the openings between crowns than they were within the drip lines of crowns. This resulted in very clumpy distributions of seedlings. In the Noman unit (unit 20, table 1), where the overstory looked like the result of heavy thinning rather than of shelterwood harvesting, Douglas-fir seedlings appeared less vigorous than associated true fir seedlings.

On the other hand, overstories can be too open. Several units (units 3, 4, 8, 9, 10, 11, and 13, table 1) have aspect, slope, and physiographic characteristics, or plantation failure histories in nearby, older clearcuts which indicate severe environmental conditions for young seedlings. Those units (8, 9, 11, and 13) with overstory densities within the range of 25 to 50 percent of normal basal area (approximately equivalent to percent of original basal area) have satisfactory stocking. The units (3, 4, and 10) with overstory densities below this range have unsatisfactory stocking. Table 1 does not indicate much difference in regeneration success between units 10 and 11. The primary difference is in distributions of seedlings, with more clumpiness in unit 10. Lower overstory density in unit 10 is due, in part, to large openings in the stand. These openings invariably were observed to have poor stocking of seedlings.

If, in anticipation of some future mortality, one assumes that 70-percent stocking is a desirable objective, then figure 4 indicates, for example, about 75 square feet of basal area as being a desirable overstory density for the average seed bed condition in this study (about 50-percent mineral soil) and for generally mesic conditions. If environmental conditions are severe (excessive heat, drought, etc.) then denser overstories might be required. Three units (8, 9, and 10, table 1), near one another in an area where plantations have repeatedly failed, substantiate this viewpoint. Unit 9 had shelterwood density of approximately 40 percent of precutting density and appeared to have the most sufficient and uniform distribution of seedlings among units 8, 9, and 10. Unit 10, with only about 16-percent residual basal area, not only had the lowest numbers of seedlings and poorest stocking among these three units, but, as mentioned before, the distribution of seedlings was clumpy. In units 9 and 13 (table 1), residual basal area of about 40 percent of original has resulted in satisfactory regeneration where severe site conditions can be expected.

The analysis relating my estimate of overstory shade to stocking percent showed that, on the average, about 50-percent shade would be needed to result in 70-percent stocking of quadrats. The amount of shade can be controlled by varying overstory density according to stand average diameter (fig. 5). For these stands,

$$Y = 13.47 + 0.38RBA - 0.0076\overline{Dq}^2,$$

$r = 0.89^{**}$ with 10 degrees of freedom. Standard error of estimate = 8.33 percent.

where:

Y = percent ground shade (ocular estimate)
RBA = residual basal area in the overstory
$\overline{Dq}$ = quadratic mean d.b.h.

Note that more overstory basal area is required to provide a given percentage of shade by bigger trees than is required of smaller trees. If, for example, average d.b.h. of residual trees is 48 inches, then about 140 square feet of basal area per acre are required to provide 50-percent ground shade. If $\overline{Dq}$ is only 24 inches, about 105 square feet of basal area are needed. In practice, the level of basal area may vary also with preharvest stand density and species composition. Formal studies on these relationships and on the influence of stand $\overline{Dq}$ are necessary to verify or improve the prediction of required residual basal area.

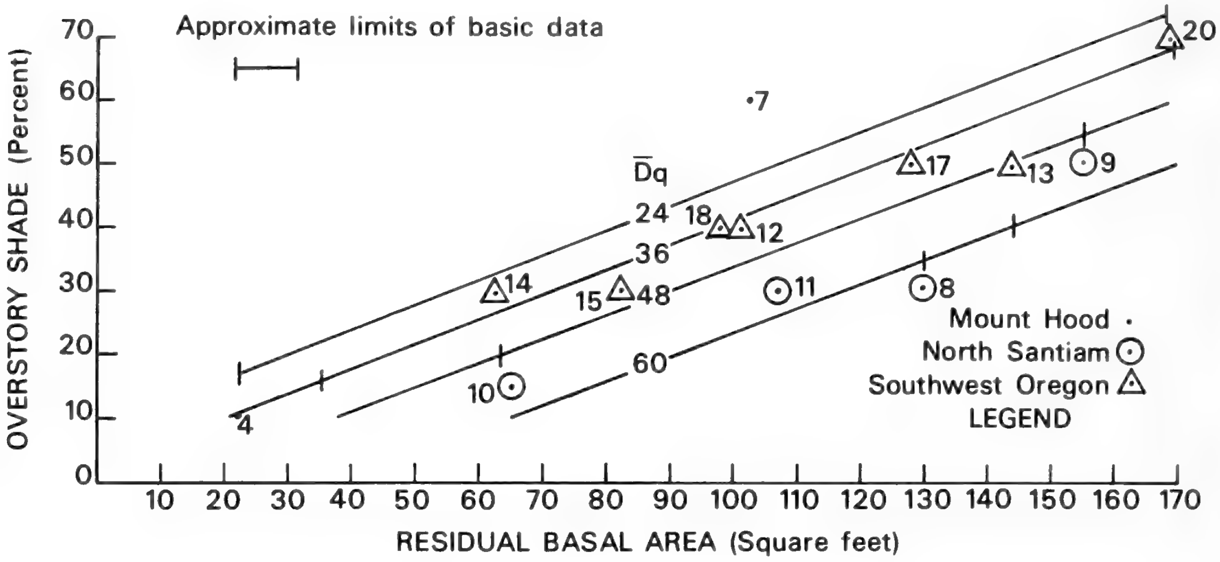


Figure 5.--*Overstory shade related to residual basal area and quadratic mean d.b.h.*

Readers may think that some of the shelterwood effects on regeneration discussed above are influenced by gross climatological and edaphic differences associated with differences in geographic location. For instance, table 1 shows that young (start of regeneration period in 1967 or 1968) units in southwestern Oregon (units 12, 13, 15, 16, and 17) have considerably greater numbers of Douglas-fir seedlings than do young units (3, 4, and 5) in the Mount Hood area. However, young units in the Mount Hood area had very light overstory densities (about 7 to 18 percent of original basal area) which appeared incapable of mitigating hostile environmental conditions. Overstory densities in young units in southwestern Oregon were heavier (about 23 to 40 percent of original basal area) and appeared much more capable of moderating environmental conditions. The trends illustrated in figure 4 are real, and this difference in seedling numbers is due primarily to overstory density.

The relatively large numbers of seedlings that occurred in the young southwest Oregon units illustrate how easily overstocking can occur when everything is "right"--good overstory density, good site preparation, and a bumper seed crop. On the other hand, if things are not "right," especially with respect to overstory density and site preparation, serious understocking can occur just as easily.

Site preparation and overstory density are probably more important than heavy seed crops in assuring adequate natural regeneration. At the start of regeneration period from 1962 through 1966, most of the older units, regardless of location, were of reasonable overstory densities (20 to 50 percent of normal basal area) and had good site preparation. All are now adequately stocked. Cone crops, however, were rated failure or light-to-failure in the period 1962-65, with no appreciable cone crop (medium-light) until 1966.[8] Since seedlings of all possible ages were observed in most units, it is obvious that some regeneration occurred during years of predicted low seed fall. It is likely that shelterwood harvesting in these units stimulated cone and seed production, as has been noted elsewhere.[9] If true, such stimulation means that land managers will not have to time shelterwood harvests with good seed crops.

Several units had topographic and physiographic features which would probably cause frost damage under clearcutting, yet no frost damage was observed under shelterwood in these units. The lowest overstory density among these frost-prone units was about 63 square feet of basal area per acre (unit 14, table 1). The equation illustrated by figure 5 indicates that this unit had about 20-percent overstory shade, which might be interpreted as being approximately equivalent to 20-percent reduction of nighttime outgoing radiation. It seems likely that shelterwood stands having density between 25 and 75 percent of original basal area will generally provide sufficient protection from frost injury.

Species Composition of Seedlings

Douglas-fir is generally represented among seedlings relative to its proportion in the overstory in an approximately linear manner (fig. 6).[10] Note that all three units on the Butte Falls District have Douglas-fir represented much more among seedlings than in the overstories. A heavy seed crop for Douglas-fir in this locality in 1968 may be responsible for this.

THE OVERSTORY

Overstory survival has been excellent with mortality over all units averaging only 2 percent by numbers of trees. Many units had no mortality. Mortality, where it occurred, was largely in species such as western hemlock and Pacific silver fir, which are very susceptible to sunscald. In exposed

---

[8] Washington (State) Department of Natural Resources. Annual cone crop reports. Also, mimeographed reports by USDA Forest Service, Region 6, giving seed collection information.

[9] E. H. Garman. Regeneration problems and their silvicultural significance in the coastal forests of British Columbia. B.C. For. Serv. Tech. Publ. T.41, 67 p., illus. 1955.

[10] Percentage data were transformed by arcsin method prior to regression analysis. The arcsin regression equation is: arcsin $Y = 32.12 + 0.417$ arcsin X. $R = 0.61^{**}$ with 18 degrees of freedom. Standard error of estimate is 13.11 degrees. Figure 6 illustrates solutions of this equation after retransformation to percentages.

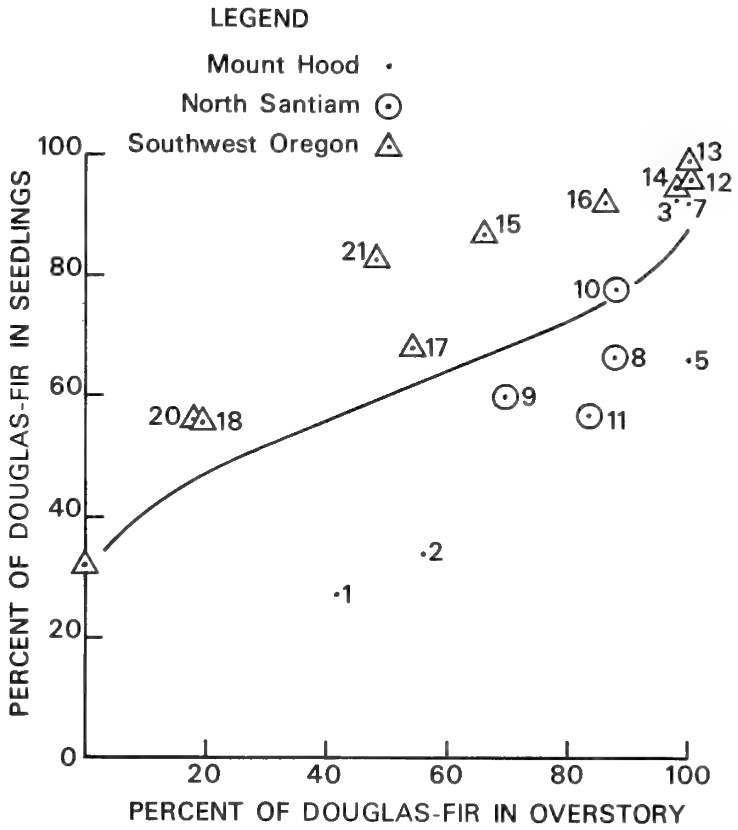


Figure 6.--*Douglas-fir seedlings and overstory trees as percentages of all species.*

locations with shallow soil, shelterwood stands that are too open are subject to possible dessication and windthrow. For example, Frazier Mountain 3 (unit 4) had shallow, wet soil, was fully exposed to east winds, and the overstory basal area was only about 10 percent of that in the original uncut stand. This unit had more mortality (17 percent) than any other unit (fig. 7). Besides windthrow, some mortality appeared to be the result of dessication.

The only other unit on shallow soil (Watson Creek, unit 15) was in a more favorable moisture and exposure environment than Frazier Mountain 3 (unit 4) and the residual stand was heavier--about one-third of the original stand. Mortality in this case was caused by windthrow only but was only 2 percent by number of trees.

The effect of overstory removal could be observed in only one unit. Here the regeneration period was judged completed after 5 years, and the overstory had been removed. Seedlings survived the overstory removal well, with a negligible drop in seedling density as indicated by stocking surveys before and after the removal cut.

Figure 7.--*Seventeen percent of the trees in Frazier Mountain 3 (unit 4) died because of windthrow or dessication.*

CONCLUSIONS

The results of this survey support an opinion made years ago by Leo Isaac[11] that shelterwood harvesting is a viable alternative to clearcut harvesting where severe site conditions exist. The evidence here also indicates that satisfactory stocking can be attained under more mesic conditions.

Adequacy of natural Douglas-fir regeneration under Douglas-fir shelterwoods in the Oregon High Cascades depends mostly on adequate exposure of mineral soil and on sufficient and uniform overstory densities. Where protection of seedlings from severe environmental conditions is required, a shelterwood stand of about 100 to 180 square feet of basal are per acre (greater amounts of residual basal area are required for trees with larger average d. b. h.) is tentatively recommended. Where conditions are favorable for both overstory and seedlings, more open shelterwood or seed-tree treatments are advisable for sufficient regeneration. In any event, shelterwood stands should consist of the most vigorous dominant or codominant trees in the original stands.

---

[11] Leo A. Isaac. Place of partial cutting in old-growth stands of the Douglas-fir region. USDA For. Serv. Pac. Northwest For. & Range Exp. Stn. Res. Pap. 16, 48 p., illus. Portland, Oreg. 1956.

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Development and evaluation of alternative methods and levels of resource management.
3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research will be made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.